

400E KEY TELEPHONE UNIT

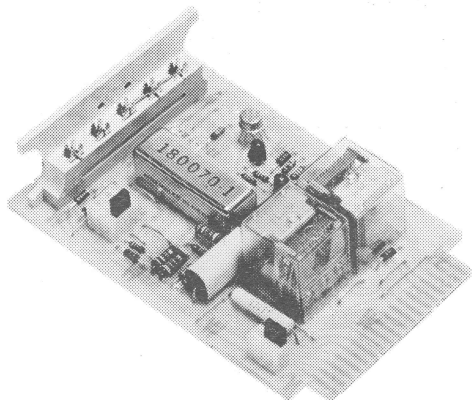


Figure 1. K400E Key Telephone Unit

1.0 GENERAL

The 400(E)962 Key Telephone Unit (KTU) is a plug-in CO/PBX line circuit for use in K-1A2 Key Telephone Systems.

The unit is interchangeable and compatible with K400B and K400D KTU's and is compatible with all types of CO's and PBX's.

A light emitting diode (LED) is provided in the circuit to indicate to a repairman if the KTU is idle or in ringing, busy, or hold condition.

Ringing bridge impedance is approximately equal to one high impedance ringer. A maximum of three ringers may be connected across the line ahead of or behind the 400E.

A non A-lead type station, dialing ahead of the line circuit, can ring-up the circuit falsely if longitudinal voltage is present and exceeds 30 volts RMS. The 400E KTU is normally unaffected by induced foreign potentials on the CO line up to approximately 24 volts RMS transversely or 90 volts RMS longitudinally.

2.0 INSTALLATION**2.1 PLUGGING IN**

400E KTU's are installed one KTU per line required. The units plug into the connectors provided in the Key Service Unit with the printed circuit side to the installer's left, (501 and 512 KSU), or on the bottom (36A KSU). Be sure the KTU is plugged in firmly. Some KSU's include a Retaining Bar to insure that the KTU's are held in position. Loosen or remove the Retaining Bar before installing the KTU's, then install the Retaining Bar and tighten the two attaching screws securely.

2.2 CIRCUIT OPTIONS

The 400E KTU provides the options listed below. It is factory wired for options Z, W, Y and BR. If other options are required, the installer must rewire or change the jumper options. (See Table A)

- Z - Short Time-out. (Used with automatic ringing CO or PBX.)
- W - Interrupted Ringing.
- T - Steady Ringing.
- V - Auxiliary Common Audible Signal Circuit.
- Y - Winking lamp on "hold".
- X - Steady lamp on "hold".
- BR - Bridged Ringing.
- RG - Ringing from ring side of line to ground.
- RU - Ringing from a separate lead to ring side of line.
- DR - Direct Ringing. (From - 24 VDC source.)
- M - Music on "hold". (Requires additional equipment.)

2.3 SPECIAL INSTRUCTIONS FOR INSTALLATION OF (DR), (M), OR (RU) OPTION**CAUTION**

PINS 3 AND 18 OF THE K400E CARD CONNECTORS PROVIDE TALK BATTERY (FILTERED -24 VDC) AND GROUND. THESE CONNECTIONS MUST BE CUT OR REMOVED IF ANY DEVIATION FROM INSTRUCTIONS GIVEN IN TABLE "A" IS USED. THIS PRECAUTION IS NECESSARY TO AVOID POSSIBLE DAMAGE TO THE K400E CARD.

Either of two methods can be used for (RU) or (DR) options: The DR or RU lead can be brought to pin 3 of the K400E KTU via system wiring or the lead can be plugged directly into option block no. 2 of the K400E KTU. Both methods are covered in Table A.

SEE NOTE AT TOP OF PAGE 3.

TABLE A. WIRING OPTIONS, K400E KTU

CODE	OPTION	OPTION BLOCK No.	STRAPPING OR JUMPER	
			(Note 1)	(Note 2)
Z	Short time-out (Factory Strapping)	(1)	1 - 2	1 - 2
W	Interrupted ringing (Factory Strapping)	(1)	5 - 8	5 - 8
T	Steady ringing	(1)	6 - 8	6 - 8
V	Auxiliary Common audible signal control	(1)	4 - 8	4 - 8
Y	Winking lamp on "hold" (Factory Strapping)	(1)	10 - 7	10 - 7
X	Steady lamp on "hold"	(1)	9 - 7	9 - 7
BR	Bridged ringing	(2)	C - D	C - D
RG	Ringng from Ring side of line to Ground	(2)	C - B	C - B
RU	Ringng from a separate lead to Ring side of line	(2)	C - C	C - A
DR	Direct ringng. (-24 V dc applied thru relay contact)	(2)	C - C	A - E
M	Music on hold. (Requires additional equipment.)	(3)	H - H	H - H

Insert (M) leads, (from K403A KTU) into "D" and "F".

NOTE

Modifications are required when using (RU) option and pushbutton-dial telephones. (The STC interconnect device reverses line polarity and the pushbutton-dial will not operate with reversed polarity.) A simple means of doing this is by reversing T and R factory wiring between the KTU connector and the connecting block at the back of the key service unit (KSU). Lift and reverse factory wiring as follows:

K501 KEY SERVICE UNIT, BLOCK "A"

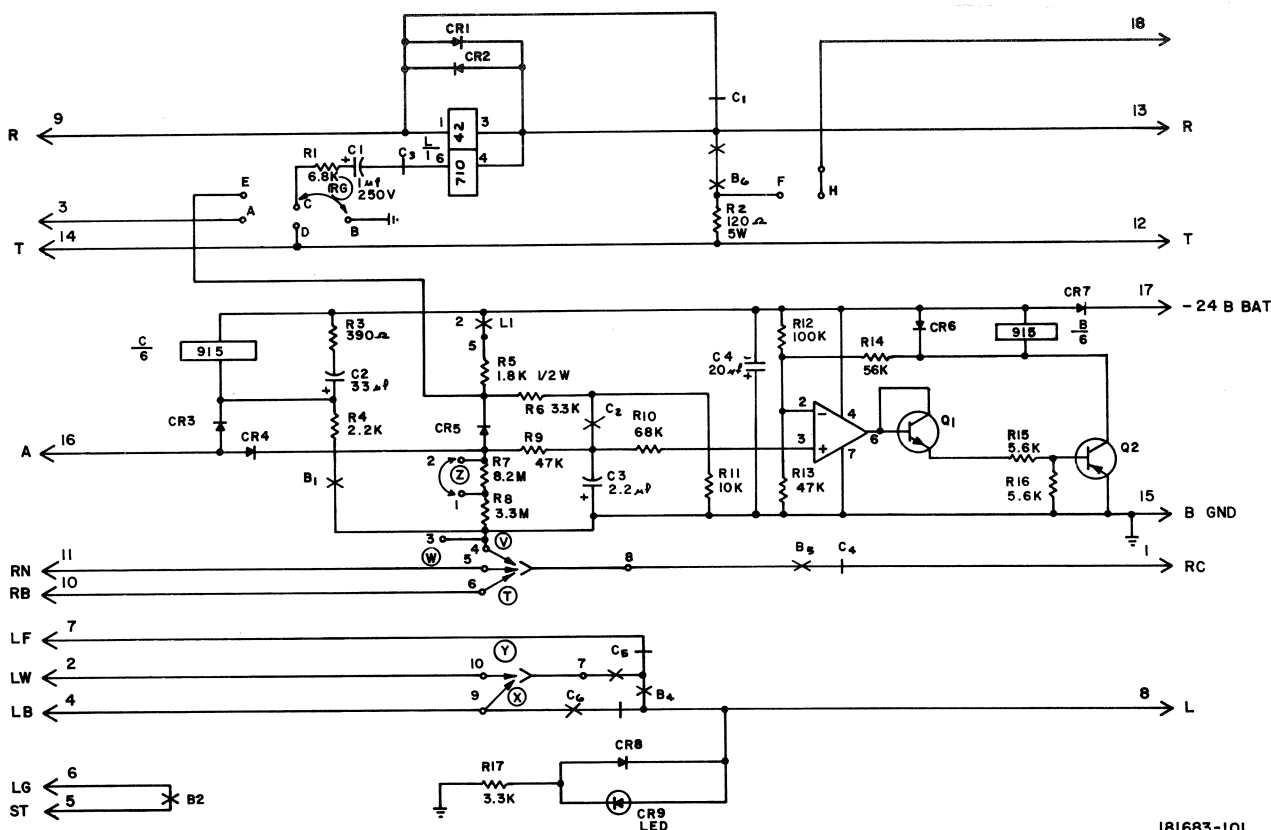
Line 1	Reverse pins	1,2	(White,Blue)
" 2	" "	7,8	(White,Brown)
" 3	" "	13,14	(Red,Orange)
" 4	" "	19,20	(Red,Slate)
" 5	" "	25,26	(Black,Green)
" 6	" "	31,32	(Yellow,Blue)

K512 KEY SERVICE UNIT, BLOCKS "A", "B", "C"

Line 1	Reverse pins	3,4	(W-O,O-W)
Line 2	" "	13,14	(R-O,O-R)
Line 3	" "	23,24	(BK-O,O-BK)
etc, etc. thru line 13			

K36A KEY SERVICE UNIT, TB 7, TB 6 Side A and B

Line 1	Reverse pins	3-4 , 5-6	(GN-GY)
Line 2	" "	18-19 ,20-21	(GN-GY)
Line 3	" "	33-34 ,35-36	(GN-GY)
etc, etc thru line 12			



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Figure 3. Circuit Schematic, K400E KTU. (Options RU, DR and M not shown. See Table A)

3.0 DESCRIPTION OF OPERATION

3.1 Idle Condition

In the idle condition all relays are in the unoperated state, and transistors Q1 and Q2 are off. The operational amplifier is held off by the bias applied to pin 2 from the voltage divider network of R12 and R13. The operational amplifier responds to the difference in voltage between pins 2 and 3. The voltage at pin 3 of the operational amplifier is determined by the charge on capacitor C3.

3.2 Ringing Current Applied

NOTE

Ringing voltage can be applied in a number of ways: from ring to ground, bridged, or on a separate lead, (see Table A for details of connections and options required). Two options are available for ringing on a separate lead: 1) Ringing voltage (105 volt 20/30 Hz) applied to the ring side of the line via the RU option and 2) "B" battery -24 volt DC) through a relay contact closure via the DR option on the 400E card.

Operation of the 400E KTU is the same in every case except for the DR option. The DR option bypasses "L" relay contacts 2 and 5. (Ringing options must be properly strapped on the board terminals.) The ringing voltage causes a current to flow through the 710 ohm winding of the L relay energizing it on the negative and positive half cycles.

When the L relay energizes, contacts 2 and 5 close. Capacitor C3 can now charge toward a -24 volts through R9, CR5, and R5. When the L relay de-energizes due to the polarity changes of the ringing voltage, C3 discharges slightly through R9, R7, and R8. After a sufficient number of cycles of ringing, the charge on C3 overcomes the bias on the operational amplifier. The operational amplifier turns on Q1 which turns on Q2. Q2 energizes the B relay. The B relay, operated, connects the LG lead to the ST lead, the L lead to the LF lead, and interrupted (option W) or steady (option T) ringing current or ground (option V) to the RC lead for audible signal control. The operational amplifier, Q1, and Q2 are held on until the call is answered or timed out.

3.3 Answering an Incoming Call

An incoming call is answered by operating the pickup key associated with the line being rung and going off-hook. The station is then connected across the line through the hookswitch and key contacts, and ringing is tripped at the Central office or PBX. Ground is also connected through the hookswitch and key contact to the A lead, operating the C relay which removes the short between terminals 1 and 3 of relay L. Relay L operates on the line current. C3 is given a quick path for discharge through the contacts of relay C and R6, R9, CR5 and CR4 and a parallel path of R11. The operational amplifier cuts off causing Q1 and Q2 to cut off and relay B to de-energize. Contacts of relay C disconnect the secondary of relay L and eliminate the shunting effect on the line of the secondary winding in series with R1 and C1. The R lead from the CO or PBX is connected to the R lead of the key set by the parallel combination of CR1 and CR2. Relays C and B connect the L lead to the LB lead and open the RC lead to discontinue local audible signaling.

3.4 Outgoing Call

By operating the pickup key associated with a line and going off-hook, the C relay associated with the line circuit KTU will have a ground placed on its coil. The R lead from the CO or PBX is connected to the R lead of the key set by the parallel connection CR1 and CR2. The C relay contacts also open the secondary of the L relay removing any shunting effect on the line and connect the L lead to the LB lead causing the lamp associated with that line on the key set to light steadily. The call can now be placed.

3.5 Holding

A busy line can be placed on hold by operating the hold key on the key telephone set. When the hold key is depressed, ground is disconnected from the A lead on the 400E line circuit KTU. Relay L has remained energized by the line current. C3 can now charge through the contacts of relay C, R6, R5 and the contacts of relay L to a negative potential. The operational amplifier conducts when the potential on C3 rises above its cutoff value and relay B is energized by the conduction of Q2. Relay B places a resistor to ground on the coil of relay C which is sufficient to allow holding current to flow through relay C. When the ground was previously removed from relay C through CR3 and the A lead, the charge on C2 was sufficient to hold relay C energized until relay B could be energized. Energizing both relay C and relay B causes line current to flow through the primary of relay L and R2 when the handset is placed on hook. The line will remain on hold until released or the held party "abandons" the call.

3.6 Release of the Holding Bridge by a Station

Any station of the key telephone system that seizes the line by operating the associated pickup key and going "off-hook" will cause the B relay to de-energize which will remove R2 from across the line. This is accomplished by grounding the A lead and giving C3 a discharge path through R6, R9, CR5, and CR4. The operational amplifier cuts off, causing Q1 and Q2 to cut off and relay B to de-energize. Relay C is held operated by the ground on the A lead and relay L is held operated by the line current to the key set. The circuit is thus restored to the busy state.

3.7 Operation with Local Power Failure

During periods when the local DC supply is inoperative it is possible to originate outgoing calls. When a station goes off-hook, connection to the line is metallic. The primary of the L relay is short circuited by the C relay contacts and the secondary is connected in series with resistor R1 and capacitor C, but this has negligible effect on the talking circuit when the BR option is used. There, however, would be an unbalanced line condition if the cord was strapped for the RG option which would result in poor transmission. If ringers are bridged across the line or a power failure circuit used, then incoming calls are signaled in the usual way although visual and common audible signals are inoperative.